Safer Foods – "One Less Thing to Worry About" —Experiences from Food Safety Performance in the U.K.

Student:Wenjing Shang[1] Advisor: Neal H. Hooker[2]

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ABSTRACT

Foodborne infection is a major cause of illness and death worldwide. Regulations able to substantially reduce the number of recalls can improve the safety of the food supply and greatly impact public health. To date, the U.S. has used a voluntary recall system. This is a *post-hazard*, "repair when needed" strategy, which creates negative externalities upon the broader economy. This study considers an alternative *ante-hazard*, "prevention" monitoring solution - the Hygiene Assessment System (HAS), in place in the U.K. meat and poultry sector since 1997. This program allocates quantitative, science-based scores to every slaughterhouse /processing plant up to once a month.

This poster presents a preliminary analysis of HAS. Statistical and time series assessments of HAS scores at various levels of aggregation (species, plant size, region, etc.) pre- and post-implementation of a HACCP-based regulation (Hazard Analysis and Critical Control Point) are conducted. In the U.K., *The Meat (HACCP) Regulations* (2002) required plants to introduce procedures based on HACCP principles and to undertake microbiological checks in red meat plants. These regulations apply to the operators of licensed fresh meat and poultry slaughterhouses; cutting plants; cold stores; re-packaging and re-wrapping centers. Operators of small and medium sized plants had until June 7, 2003 to comply. With non-parametric statistics method, this poster presents HAS scores differ by plant size, business type (meat/poultry), plant location and pre- and post-HACCP.

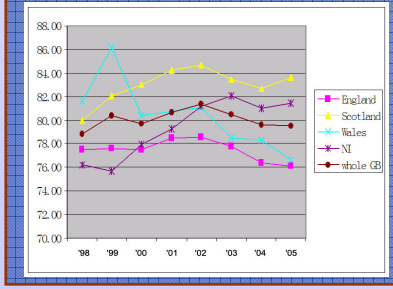
WHAT IS HAS?

The Hygiene Assessment System (HAS) is an ante-hazard monitoring and reporting scheme in the U.K. meat and poultry industry from 1997 to 2005. The results of HAS were reported on a public website at a monthly plant level. In the U.K. hygiene standards in all licensed slaughterhouses and cutting plants are monitored using HAS. The system was developed as an objective, risk-based method of assessing hygiene standards. It was designed to assess hygiene hazards which may arise during slaughter including, the people working in the plant, the plants themselves and any other relevant sources of hazards.

Plants were assessed by an Official Veterinary Surgeon (OVS) against performance criteria covering all significant aspects of production, each weighted according to their relative public health risk. The results enable the Meat Hygiene Service (MHS) of the U.K.'s Food Standards Agency (FSA) to monitor the performance of licensed plants and to identify those plants where additional supervision and enforcement action might be necessary. Because the most significant risks to the product are given the heaviest weighting, the system helps focus attention on public health issues. The end product of an assessment under the system is a "HAS score", a value between 0-100, with higher scores indicating better performance.

PRELIMINARY ANALYSIS OF HAS

Complete HAS data is available for the years 1998 to 2005. The number of licensed plants had been declining over this period. In the Great Britain (GB), which includes England, Scotland and Wales, it went from 1,353 in early 1998 to 1,269 by late 2005. Similarly, in Northern Island (NI), plant numbers declined by ten percent from nearly 100 in early 1998 to around 90 in late 2005. Plants may either close or merge to form larger operations.



Average HAS scores follow different paths across regions and business types. Scotland has the highest average scores, followed by Wales, and then NI, with England having the lowest average scores. This figure similarly highlights that Scotland and NI have improved their hygiene performance on average, while England has remained constant and Wales has declined. Overall HAS scores in the U.K. increased over the period.

NONPARAMETRIC TESTS

After considering trends in HAS scores across regions, it is interesting to determine if there are systematic differences using nonparametric statistics as the distribution of the HAS scores over the years is unknown. Also, we would like to see whether HACCP implementation improved HAS scores or not. The following nonparametric comparisons are presented:

1.Pre- and post- HACCP HAS scores.

2.HAS scores in each of the four regions, England, Scotland, Wales, and NI in the U.K.

3.HAS scores at a plant level: between large and small plants, between red meat and poultry meat plants, and between slaughterhouses and cutting plants, respectively.

1. PRE- AND POST- HACCP SCORES

- Hazard Analysis Critical Control Point (HACCP) is an internationally recognized and recommended system of food safety management. It focuses on identifying the 'critical points' in a process where food safety problems (or 'hazards') could arise then adopting practices to prevent things from going wrong and ensuring the effectiveness of these practices with monitoring. This is sometimes referred to as 'controlling hazards'. Keeping records is an important part of HACCP systems. HACCP implementation by June 7, 2002 for large plants and June 7, 2003 for small plants.
- Use Wilcoxon rank-sum test
- For large plants, there was no change in HAS scores pre- and post-HACCP (90% confidence level)
- For small plants, HAS scores went up after HACCP was implemented (99% confidence level).

2. REGIONAL DIFFERENCES IN SCORES

- Friedman's distribution-free test for unordered alternatives - HAS scores differ by geographic region (99% confidence level).
- Multiple comparisons for the 2-way lay-out. 4 regions, 6 pairs. Only Scotland > England (99% confidence level). So no other conclusion can be made for ordering four regions' HAS scores. (See figure on the lower left.)
- One possible reason of Scotland's better hygiene performance could be the cooler weather in Scotland, where plants may experience lower levels of hygiene hazards. Or the MHS staff in Scotland region might tend to give higher scores.

3. COMPARING SCORES AT A PLANT LEVEL

Wilcoxon signed rank test is used in all the following three comparisons.

(1) Large vs. small plants. Small plants are facilities processing 20 or less livestock units per week.

- Average scores: large plants (81.8)
  small plants (78.4)
- Test statistics: $T^+ = 496$ ($>t_{0.0099}=366$)
- Large plants score higher than small plants.


(2) Red meat vs. poultry meat plants.

- Average scores: read meat plants (77.3)
  poultry meat plants (76.6)
- Test statistics: $T^+ = 322$ ($\geq t_{0.078}=322$)
- Red meat plants score higher than poultry meat plants.


(3) Slaughterhouses vs. cutting plants.

- Average scores: slaughterhouses (77.0)
  cutting plants (83.3)
- Test statistics: $T^+ = 0$ ($< n(n+1)/2 - t_{0.0099}=130$)
- Cutting plants score higher than slaughterhouses.


NONPARAMETRICS THEORY

- No assumption is made regarding the normality of the populations.
- A Wilcoxon rank-sum test is to determine whether there is a difference between two independent populations, thus it is appropriate in the pre- and post- HACCP studies. The null hypothesis H_0 is "There is no change in HAS scores following the implementation of HACCP", and the alternative hypothesis H_1 is "There is a change in HAS scores following the implementation of HACCP"
- In the regional differences comparison, because the data is pair-wise instead of random, the Kruskal-Wallis test is inappropriate. The Friedman test applies a block design, which should be used here. The null hypothesis H_0 is "scores don't differ systematically" ($\tau_1=\tau_2=\ldots=\tau_n$), and the alternative hypothesis H_1 is "at least two groups are systematically different in scores".
- Wilcoxon signed rank test is an alternative to the paired Student's t-test, thus can be used in the plant-level comparisons. The null hypothesis H_0 is "no treatment effect"($\theta=X_i-Y_i=0$), and the alternative hypothesis H_1 is $\theta \neq 0$.

CONCLUSIONS

- Looking at UK, HAS scores don't change much over time
  - –MHS has been consistent with HAS inspection standards
- HAS scores didn't change after the HACCP implementation in large plants
  - –HAS scores in small plants went up after HACCP
- HAS scores differ regionally
  - –Scotland scores higher than England.
- HAS scores differ by business type
  - –Large plants do better than small plants
  - –Red meat plants do better than poultry meat plants
  - –Cutting plants do better than slaughterhouses
- All these tell us, slaughterhouses, smaller-sized slaughterhouses, smaller-sized poultry meat slaughterhouses, and plants in England, should receive more attention to help improve their hygiene performances.

FUTURE STUDIES

- With more detailed plant-level data, econometric model on how specific plant characteristics impact HAS scores can be operated.
- Some plants had constant high scores over the years, e.g.100. It will be interesting to see why certain plants had superior hygiene performance.
- Starting from Jan.1, 2006, the Audit system replaced HAS. Until 31 December 2005 OVSs will continue to complete HAS checklists in slaughterhouses and cutting premises. The latest three monthly average HAS scores of individual licensed meat premises will be published monthly on the FSA website. Audit questionnaires will replace HAS checklists. This means that HAS scores will no longer be available for publication. Once a full audit visit has been carried out, the audit category will be published in place of the HAS score. Instead of visiting each plant every month, this scheme gives a minimum audit frequency for different types of plants, based on how they perform in the previous audit. It ranges from at least once every 2 months to at least once every 12 months.
- Also, instead of giving continuous scores from 0 to 100, the Audit system gives outcome into four levels, excellent, satisfactory, some and poor. Standards depend on the type of plants, like what kind of meat they handle. So again, this also proves that our study have empirical meanings.

ACKNOLEDGEMENT

1. Ph.D. student, Department of Agricultural, Environmental, and Development Economics. The Ohio State University. Email: shang.13@osu.edu.

2. Assistant Professor, Department of Agricultural, and Environmental, Development Economics. The Ohio State University. Email: hooker.27@osu.edu